Modeling and Visualizing Wildfire Risk and Impacts:

Assessing Wildfire Threat, Communities-at-Risk, Economic Exposure and Return on Investment for Mitigation Planning

David Buckley

Sanborn Map Company, Colorado Springs, Colorado
Email: DBuckley@sanborn.com; Website www.sanborn.com

Joseph K, Berry

W. M. Keck Visiting Scholar in Geosciences, Geography, University of Denver
Principal, Berry & Associates // Spatial Information Systems (BASIS), Fort Collins, Colorado
Email: jberry@innovativegis.com; Website: www.innovativegis.com

David Bouwman

DTS Agile, Fort Collins, Colorado
Email: dbouwman@edats.com; Website: www.edats.com

Skip Edel

Colorado State Forest Service, Golden District, Golden, Colorado
Email: sedel@lamar.colostate.edu, Website http://csfs.colostate.edu

Paper presented at GIS in the Rockies Conference, September 16-18, 2009, Loveland, Colorado

Abstract

Wildfires are a growing problem across the Nation as climate change extends our fire seasons. Coupled with a historical policy of aggressively fighting fires, this has resulted in a buildup of volatile vegetation and fuels. In addition, the consequence of wildfires has never been greater as the trend continues of people moving into the wildland. The Wildland Urban Interface (WUI) is the combat zone for wildfires – with significant potential social, economic and environmental impacts. With urban growth and expansion into wildland areas there has been a significant increase in risk to people and their homes.

Fire professionals in all agencies are challenged with how to reduce the risk to wildfire in the WUI, while responsibly allocating budgets to high priority areas for preparedness planning and response and suppression. It is clear that there is an increasing need for fuel treatments, mitigation planning, and prevention to reduce the risk to communities in the WUI.

To date, the lack of consistent, accurate information limits the success of preparedness planning. There is a general lack of reliable information to support decision making – including mitigation planning, prevention and response and suppression. Fire planners are challenged to quantify the risk to communities and prioritize mitigation efforts to best protect people and their homes. In addition, with the current economic situation, there is an increasing demand to document accomplishments and performance measures – what is the effect of our mitigation efforts, and are we spending our budgets efficiently?

This presentation focuses on the utility of geotechnology, map analysis procedures and web based visualization and delivery options in the assessment and planning process, not only for identifying areas of greatest risk, but also quantifying the dollar impact of wildfire and proposed mitigation efforts. This includes development of the following distinct phases: 1) ***Wildfire Threat*** defining the probability of a wildfire occurring based on the integration of historical weather and occurrence data with fire behavior models, 2) ***Wildfire Risk*** defining those areas with the greatest possibility of being impacted by a fire, 3) ***Community Wildfire Protection Planning*** which identifies those highly vulnerable communities, and provides the required risk data for development of mitigation plans for those communities, 4) ***Economic Exposure*** identifying estimated loss by integrating threat with economic data, and 5) ***Return on Investment*** for evaluating different mitigation alternatives. The assessment methodologies can be applied at both strategic and tactical scales.

These tools not only provide the basis for more informed decision making, but also a consistent basis for funding allocation. The use of ***geo-web mapping and visualization*** capabilities is also discussed as the primary mechanism for delivering data and functionality to interested stakeholders. The paper describes results and lessons learned in applying these wildfire modeling approaches in California, Colorado and the Southern states.

PowerPoint posted at **www.innovativegis.com/basis/Present/GIS_Rockies09/GISTR09_wildfire.ppt**

Supporting paper posted at **www.innovativegis.com/basis/present/GW09_wildfire/Wildfire_GW09.htm**

Prototype geo-web demo at **http://demo.dtsagile.com/wildfire/**

Living with Wildfire *(Wildland/Urban Interface)*

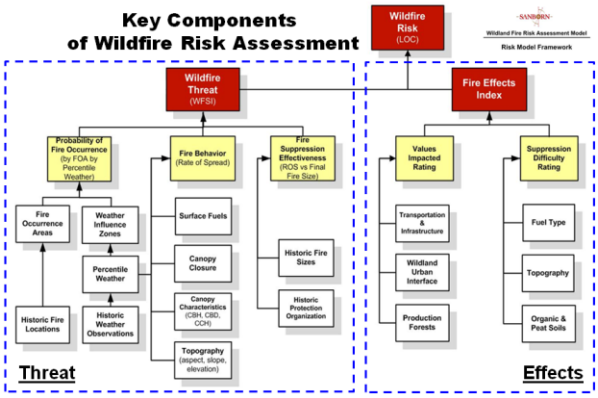
Increased population *growth into the wildland/urban interface* ***raises the danger*** *of disaster...*

...creating need for a practical method to identify ***areas most likely to be impacted by wildfire*** *so effective pre-treatment, suppression and recovery plans can be developed and implemented*

Technical Approach *(model flowchart)*

Wildfire Risk = fn(Wildfire Threat, Fire Effects)
Wildfire Effects = fn(Values Impacted, Suppression Difficulty)
Wildfire Threat = fn(Probability of Occurrence, Fire Behavior, Suppression

Key Components of Wildfire Risk Assessment



Wildfire Threat *(Colorado Example/Demo)*

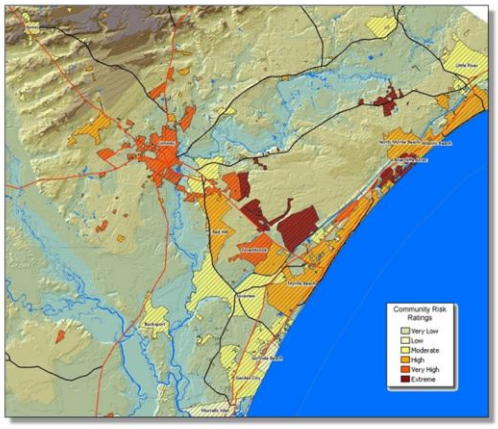
Wildfire Threat is mapped at a 30m resolution for the forested areas within the state and delivered via the Internet in a variety of interactive map products...
http://demo.dtsagile.com/wildfire/


(Live Demo of prototype system)

Determining Community-at-Risk Ratings

- Wildfire Threat values within a 3 mi. proximity buffer of each community was used to derive CAR ratings

...average Threat value for each community



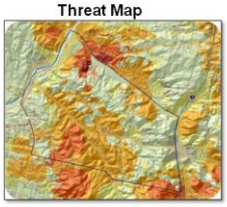
Economic Impact Analysis *(underlying theory)*

In general Risk Modeling theory,
"**Risk** is the product of Probability (**Threat** likelihood) and the **Impact**/Consequences of a Hazard"

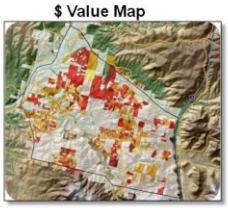
Threat x $ Value = Exposure

- **Quantify the Dollar Exposure** (economic impact)
- **Quantify the ROI for Mitigation** (treatments)

Threat Map



$ Value Map



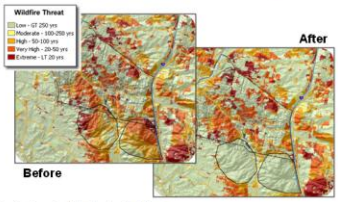
2) Damage Exposure *(ROI Calculations for Mitigation)*

Using analysis tools to evaluate the impact of fuel treatments on potential loss of structures...

1. **Simulate fuel treatments**
2. **Calculate the change in vegetation fuels**
3. **Calculate the change in wildfire threat**
4. **Calculate the change in dollar exposure (economic impact of treatment)**

– **Determine the ROI for mitigation fuel treatments**

($ Before - $ After) / $ Treatment = ROI



PowerPoint posted at **www.innovativegis.com/basis/Present/GIS_Rockies09/GISTR09_wildfire.ppt**